Citation:

Allman-Farinelli MA, Gomes K, Favaloro EJ, Petocz P. A diet rich in high-oleic acid sunflower oil favorably alters low-density lipoprotein cholesterol, triglycerides, and factor VII coagulant activity. *J Am Diet Assoc* 2005; 105:1071-1079.

PubMed ID: 15983523

Study Design:

Randomized Crossover Trial

Class:

A - Click here for explanation of classification scheme.

Research Design and Implementation Rating:

NEUTRAL: See Research Design and Implementation Criteria Checklist below.

Research Purpose:

To compare concentrations of factor VII coagulant activity (factor VIIc), fibrinogen, plasminogen, activator inhibitor-1, and blood lipids on a saturated fat-rich (SFA) diet with one rich in monounsaturated fat (MUFA).

Inclusion Criteria:

- Aged 35 - 69 years
- No chronic illness
- Body mass index (BMI): 23 - 29 kg/m^2
- Total cholesterol < 7.5 mmol/L
- Triglyceride < 3 mmol/L
- Normal liver function tests and electrolytes
- Fasting glucose < 6.8 mmol/L
- Normal full blood count
- Blood pressure < 160/95 mm Hg
- Nonsmoker
- No medications including nutrition supplements

Exclusion Criteria:

- Individuals with established hyperlipidemia requiring treatment

Description of Study Protocol:

Recruitment: Subjects were recruited using publicity channels within the University of Sydney.

Design: Randomized, crossover trial with ABB/BAA extra period crossover

Blinding used (if applicable): not specified

Intervention (if applicable)

- Macronutrient composition: protein: 15% energy; carbohydrate: 45% energy; fat: 40% energy
- Fat composition manipulated by test spreads and oils (provided by study investigators)
    - Diet high in monounsaturated fatty acid (MUFA): high oleic acid margarine and oil (Sunola, Meadow Lea Foods, Mascot, Australia)
    - Diet high in saturated fatty acid (SFA): butter and hard cooking fat (stearine, Meadow Lea Foods, Mascot, Australia)
- Subjects instructed on diet plan:
    - Foods supplied by study: test fats, biscuits containing the appropriate fat, and muffin mix as a medium to incorporate the test fat, milk, bread, cereal and fat-free salad dressing
    - Foods that could be included and supplied by subject: fruit, vegetables, meat or chicken, reduced-fat cheese, small amount of sugar
    - Subjects were advised against foods that might alter fat composition, especially additional sources of n-9, n-3, and n-6 fatty acids

Statistical Analysis

- Analysis of ABB/BAA extra-period crossover with sequence, period, treatment, and carryover as fixed effects and subject as random effect : general linear model (SPSS, version 11.0, 2001)
- Level of significance was $P < 0.05$
- Adjustment for multiple comparisons of plasma lipids and fatty acids: $P < 0.01$ and $P < 0.0025$ were selected a priori.
- Comparisons of subject characteristics at baseline: two-sample *t*-test

Data Collection Summary:

Timing of Measurements

- Blood samples collected and weight measured at baseline and at end of each 5 week diet period
    - Baseline
    - 5 weeks
    - 10 weeks
    - 15 weeks
- 3 day food diaries on two occasions during each diet period

Dependent Variables

- Blood lipids:
    - plasma total and high-density lipoprotein (HDL) cholesterol [total, HDL2 directly after precipitation, and HDL3 by difference], triglycerides - Cobas Fara autoanalyzer
    - low density lipoprotein (LDL) cholesterol - Friedewald equation
    - apolipoprotein A-1 and B - Turbiquant Turbitime method
- Plasma fatty acids
- Coagulation and fibrinolysis factors

- factor VIIc - automated coagulation laboratory analyzer using one-stage clotting assays
- fibrinogen - one-stage clotting assay
- plasminogen activator inhibitor-1 (PAI-1) activity - Spectrolyse pL PAI kit (Biopool, Umea, Sweden)

- Insulin (immunometric method (Abbott Ax SYM System, Germany)

Independent Variables

- Dietary intake of SFA and MUFA
  - provided foods assayed for fat content
  - 2 sets of 3 day food diaries during each diet period

Control Variables

Description of Actual Data Sample:

Initial N: 18 subjects recruited

Attrition (final N): 15 completed (male N = 5; female N = 10)

Age: (mean ± SEM)

- SFA/MUFA diet (N=9): 45 ± 2 years
- MUFA/SFA diet (N=6): 46 ± 2 years

Ethnicity: Not specified

Other relevant demographics: None specified

Anthropometrics

BMI (kg/m^2) (mean + SEM)

- SFA/MUFA diet: 24.5 + 0.7
- MUFA/SFA diet: 25.2 + 1.2

Location: University of Sydney, Sydney Australia

Summary of Results:

Key Findings

- Factor VIIc was lower on the MUFA-rich diet ($P < 0.05$)
- Fibrinogen and insulin concentrations and PAI-1 activity did not differ between the diets
- With MUFA diet, compared to SFA diet, total cholesterol, LDL cholesterol ($P < 0.001$ for both) and triglycerides ($P < 0.01$) were lower, as well as the trend for HDL2 ($P=0.016$) and apolipoprotein B ($P = 0.027$, adjusted level of significance = $P < 0.01$)
- A significant increase in both plasma phospholipid and neutral lipid oleic acid ($P < 0.0001$) occurred on the MUFA diet

Compliance and dietary analysis

- Subjects selected a diet lower in fat than that in which they had been instructed.

- Percentage of energy from protein, carbohydrate, and fat, and total dietary fiber intake were the same on both diets
- Lower fat intake was consistent throughout the three diet periods
- Differential between the MUFA intake on the two diets = 10.7% of total energy intake
- Cholesterol intake was higher on the SFA-rich diet ($P < 0.05$)
- Dietary compliance was confirmed by a significant increase in both plasma phospholipid and neutral lipid oleic acid ($P < 0.0001$) when subjects consumed the MUFA diet
- Weight was maintained throughout the study

Blood Lipids

- No significant period or carryover effect was detected for any of the variables studies, except factor VIIc: period effect: $P = 0.012$; carryover effect: $P = 0.240$

Other Findings

- C18:0 fatty acid was significantly higher in neutral lipids during SFA diet ($P < 0.002$)
- C18:1 fatty acid was significantly higher in neutral and phospholipids during SFA diet ($P < 0.0001$)

Author Conclusion:

Substitution of foods rich in saturated fat with foods rich in high-oleic-acid sunflower oil and margarine has favorable outcomes on blood lipids and factor VIIc. This oil presents another useful source of MUFA for diets aimed at prevention of heart disease.

Reviewer Comments:

Relatively small sample size, test periods only 5 weeks in duration.

Research Design and Implementation Criteria Checklist: Primary Research

Relevance Questions

1.	Would implementing the studied intervention or procedure (if found successful) result in improved outcomes for the patients/clients/population group? (Not Applicable for some epidemiological studies)	Yes
2.	Did the authors study an outcome (dependent variable) or topic that the patients/clients/population group would care about?	Yes
3.	Is the focus of the intervention or procedure (independent variable) or topic of study a common issue of concern to nutrition or dietetics practice?	Yes
4.	Is the intervention or procedure feasible? (NA for some epidemiological studies)	Yes

Validity Questions

1.	**Was the research question clearly stated?**	Yes
1.1.	Was (were) the specific intervention(s) or procedure(s) [independent variable(s)] identified?	Yes
1.2.	Was (were) the outcome(s) [dependent variable(s)] clearly indicated?	Yes
1.3.	Were the target population and setting specified?	Yes
2.	**Was the selection of study subjects/patients free from bias?**	???
2.1.	Were inclusion/exclusion criteria specified (e.g., risk, point in disease progression, diagnostic or prognosis criteria), and with sufficient detail and without omitting criteria critical to the study?	Yes
2.2.	Were criteria applied equally to all study groups?	Yes
2.3.	Were health, demographics, and other characteristics of subjects described?	Yes
2.4.	Were the subjects/patients a representative sample of the relevant population?	???
3.	**Were study groups comparable?**	Yes
3.1.	Was the method of assigning subjects/patients to groups described and unbiased? (Method of randomization identified if RCT)	Yes
3.2.	Were distribution of disease status, prognostic factors, and other factors (e.g., demographics) similar across study groups at baseline?	Yes
3.3.	Were concurrent controls used? (Concurrent preferred over historical controls.)	Yes
3.4.	If cohort study or cross-sectional study, were groups comparable on important confounding factors and/or were preexisting differences accounted for by using appropriate adjustments in statistical analysis?	N/A
3.5.	If case control or cross-sectional study, were potential confounding factors comparable for cases and controls? (If case series or trial with subjects serving as own control, this criterion is not applicable. Criterion may not be applicable in some cross-sectional studies.)	N/A
3.6.	If diagnostic test, was there an independent blind comparison with an appropriate reference standard (e.g., "gold standard")?	N/A
4.	**Was method of handling withdrawals described?**	Yes
4.1.	Were follow-up methods described and the same for all groups?	Yes
4.2.	Was the number, characteristics of withdrawals (i.e., dropouts, lost to follow up, attrition rate) and/or response rate (cross-sectional studies) described for each group? (Follow up goal for a strong study is 80%.)	Yes

4.3.	Were all enrolled subjects/patients (in the original sample) accounted for?	Yes
4.4.	Were reasons for withdrawals similar across groups?	???
4.5.	If diagnostic test, was decision to perform reference test not dependent on results of test under study?	N/A
5.	**Was blinding used to prevent introduction of bias?**	Yes
5.1.	In intervention study, were subjects, clinicians/practitioners, and investigators blinded to treatment group, as appropriate?	N/A
5.2.	Were data collectors blinded for outcomes assessment? (If outcome is measured using an objective test, such as a lab value, this criterion is assumed to be met.)	Yes
5.3.	In cohort study or cross-sectional study, were measurements of outcomes and risk factors blinded?	N/A
5.4.	In case control study, was case definition explicit and case ascertainment not influenced by exposure status?	N/A
5.5.	In diagnostic study, were test results blinded to patient history and other test results?	N/A
6.	**Were intervention/therapeutic regimens/exposure factor or procedure and any comparison(s) described in detail? Were interveningfactors described?**	???
6.1.	In RCT or other intervention trial, were protocols described for all regimens studied?	Yes
6.2.	In observational study, were interventions, study settings, and clinicians/provider described?	N/A
6.3.	Was the intensity and duration of the intervention or exposure factor sufficient to produce a meaningful effect?	???
6.4.	Was the amount of exposure and, if relevant, subject/patient compliance measured?	Yes
6.5.	Were co-interventions (e.g., ancillary treatments, other therapies) described?	N/A
6.6.	Were extra or unplanned treatments described?	N/A
6.7.	Was the information for 6.4, 6.5, and 6.6 assessed the same way for all groups?	Yes
6.8.	In diagnostic study, were details of test administration and replication sufficient?	N/A
7.	**Were outcomes clearly defined and the measurements valid and reliable?**	Yes
7.1.	Were primary and secondary endpoints described and relevant to the question?	Yes
7.2.	Were nutrition measures appropriate to question and outcomes of concern?	Yes

7.3.	Was the period of follow-up long enough for important outcome(s) to occur?	Yes
7.4.	Were the observations and measurements based on standard, valid, and reliable data collection instruments/tests/procedures?	Yes
7.5.	Was the measurement of effect at an appropriate level of precision?	Yes
7.6.	Were other factors accounted for (measured) that could affect outcomes?	Yes
7.7.	Were the measurements conducted consistently across groups?	Yes
8.	**Was the statistical analysis appropriate for the study design and type of outcome indicators?**	???
8.1.	Were statistical analyses adequately described and the results reported appropriately?	Yes
8.2.	Were correct statistical tests used and assumptions of test not violated?	???
8.3.	Were statistics reported with levels of significance and/or confidence intervals?	Yes
8.4.	Was "intent to treat" analysis of outcomes done (and as appropriate, was there an analysis of outcomes for those maximally exposed or a dose-response analysis)?	N/A
8.5.	Were adequate adjustments made for effects of confounding factors that might have affected the outcomes (e.g., multivariate analyses)?	Yes
8.6.	Was clinical significance as well as statistical significance reported?	Yes
8.7.	If negative findings, was a power calculation reported to address type 2 error?	No
9.	**Are conclusions supported by results with biases and limitations taken into consideration?**	Yes
9.1.	Is there a discussion of findings?	Yes
9.2.	Are biases and study limitations identified and discussed?	Yes
10.	**Is bias due to study's funding or sponsorship unlikely?**	???
10.1.	Were sources of funding and investigators' affiliations described?	Yes
10.2.	Was the study free from apparent conflict of interest?	???